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THE JOURNAL OF GEOGRAPHY

VOL. V MARCH, 1906 No. 3

LABORATORY WORK WITH THE SUN

By J. PAUL GOODE
Assistant Professor of Geography, University of Chicago

THE attitude of the sun to the earth is most vital. With the sun high in the sky day after day a warm climate results. With an increase in the length of day, that is, with an increase in the number of hours of sunlight, summer returns to the higher latitude. On a summer day the temperature of the air rises rapidly with the rising sun, and culminates some time after the culmination of the sun; and the coolness of evening becomes very apparent before the sun has set. These things are noticed in a general way in the study of geography and physiography, but it is not often that any attempt is made to make observations quantitative. Crude and simple devices are sometimes provided by ingenious teachers, and very satisfactory results are gained, and a very earnest interest aroused. Sometimes very accurate results are gained by such devices. But more often the limitations of the apparatus offer a real obstacle to any quantitative work, making observations valuable merely in a qualitative way.

The principles involved in taking quantitative observations on the sun are simple. They are not too difficult for the intermediate grades. The circle and its elements; even the sines, tangents and co-tangents, as geometrical relations, if observed, and dealt with graphically, are fascinating to a fifth grade boy. Give him the compasses, the protractor and scale, and put the angles before him to be read, and he will take pleasure in solving many problems. The actual instrumental work fixes the principles in the memory of the observer as no amount of drill on the mere formulas ever can do. To make it possible at a minimum expense, for teacher and student to do the instrumental work, the author has devised a little instrument with the homely name of Sun Board. It is only five inches across, carrying within

its outer rim a movable horizon about three inches in diameter. Upon this horizon is a doorway an inch high thru which the sun may shine. Behind the doorway is a quadrant upon which the sun may cast the shadow of the top of the front board, so making it possible to read the sun's altitude direct. Thru the horizon a diameter with a scale alongside is etched from the middle of the doorway so that shadow lengths may be read upon the horizon. Three leveling screws beneath the frame of the instrument, and a plumb line hanging in front of the doorway, make it possible to establish the horizon. Opposite the doorway a hinged beam box makes it possible to read from a scale the power of a sunbeam in heating the surface upon which it falls.

Several other relations may be demonstrated with the instrument, and it may be worth while to make a list of its uses, and to suggest a number of problems which may be solved by its use.

1. *To Establish the Horizon.* Put the Sun Board upon the window sill, or floor, or some firm, approximately level surface, and adjust the level by the three leveling screws. The level will be established when the plumb line rests in the middle of the hole in front of the doorway. This hole is only about two millimeters in diameter, so the adjustment is close. The principle involved here is that a level surface is at right angles to the "line of direction," and the line of direction is the path taken by a falling body, or by a string hanging freely and supporting a weight *e. g.*, the plumb line. The plumb line is then a line vertical to the established horizon.

2. *To Read the Sun's Azimuth,* (or angular distance from the south point). In meteorology all positions in the horizon are read in degrees from the south point around by way of the west. West is thus 90°, north 180°, east 270°, and so on.

Place the Sun Board with its south and north points in the meridian, which, for the present exercise, may be determined by means of a compass. Turn the movable horizon until the doorway faces the sun, and watch the shadow of the plumb line as it falls under the doorway. When this

shadow coincides with the scaled diameter crossing the horizon of the instrument, the doorway end of this diameter gives the reading of the sun's azimuth, on the graduated circle on the stationary frame of the instrument. The plumb line being vertical, may be considered as an element in a vertical circle, and when its shadow coincides with a diameter of the movable horizon, we have located the vertical circle passing thru the sun and the zenith. The angle in the horizon between the south point and this vertical circle, is the azimuth. A vernier limb is engraved upon the movable horizon making it possible to read the azimuth to 15 minutes of arc. Any time in the day, then, from sunrise to sunset, azimuth may be read with great ease. But a meridian established by a compass is not reliable. One cannot be sure that it is true.

3. *To Establish the True Meridian.* Where *is* the south point? This seems an easy question, until we look it squarely in the face. We may fix the meridian with more or less accuracy in several ways:—

(a.) We may locate it with a compass, if the compass is accurately made, and if it is not influenced locally by iron or steel objects. But the compass needle does not point to the true north except along the line of no variation, which in this country runs near Detroit, and Charleston, S. C. The observer needs to know then the exact amount the needle varies from the true north in his locality. This is very hard to find, for when an approximate value is taken from the chart of magnetic variation, there are in many places rather large local variations, a fact which puts our compass readings in some doubt. Then too, the variation for our locality as found, must be dated because a slow change in the value of the magnetic variation is in progress, adding another uncertainty to the list. So the compass is far from being a satisfactory means of establishing the true meridian.

(b.) Given an accurate clock or watch, we may set it at the time of sunrise or sunset, as given in the almanac, and so establish our meridian by the shadow of a vertical stick at the instant of noon by the clock. But a number of errors may enter here. For example, the sun's disc covers an arc of about half a degree and the true instant of sunrise is when the center of this disc crosses the horizon. An ordinary observer must guess at this instant, or he may take the instant the disc first appears, and make a correction for the semi-diameter of the disc. This is not a serious error. It would make a difference of less than a degree in the true reading of the meridian. Again the times of sunrise and sunset are given in the ordinary almanac for only two or three latitudes in our whole wide area. If the observer does not live in these particular latitudes, errors of judgment are

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certain to enter, and the possibility of error increases with the increase in latitude. And again a much greater possibility of error confronts us, in that the sun crosses the meridian at the clock noon, it may be, only once in the year, and on only four days in the year will it come within six or seven seconds of it. On all other days the sun will be either faster or slower than the clock, the maximum error being over 16 minutes. So one must refer again to a table in the almanac to find the exact time at which the sun crosses the meridian on the day the observation is to be made.

(c.) With the Sun Board the problem is very simple. If we can install it where we may take azimuth readings at sunrise and sunset, we may divide the horizontal angle between these two readings, and have our true south point. For this first determination, the instrument may be put down in any random position, so far as concerns the point upon it marked "south," for all one needs to do is to get a reading for the horizontal angle between these two points. When the reading of the midpoint between sunrise and sunset has been found, still being careful not to move the instrument, rotate the horizon, to bring the zero of the vernier limb, to this reading. Now the plumb line, and the vertical wire in the beam box, (when the box is in the horizontal position), will serve as two sights, to control the erection of two pins or wires which may be driven into the floor or window sill, and between which a permanent line may be drawn, as the position of the meridian. This position will be true to within fifteen minutes of arc.

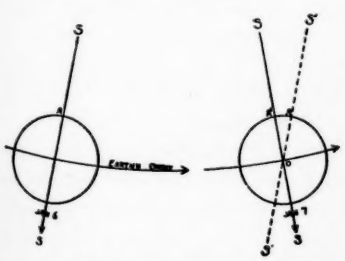
It is not absolutely essential to have the Sun Board in the sunlight at sunrise and sunset. It may be put in any south window and the meridian determined as follows: Take an azimuth reading in the forenoon, when the sun has a given altitude, say 45° (see problem 6, below), and then take the azimuth reading in the afternoon, when the sun has fallen again to an altitude of 45°. The midpoint between these two readings, is the south point, and the meridian may be established as above described.

It will be noticed that this is the *true meridian.* The sun will cast its shadow on this line, at noon by the clock on only four days in the year, even if the clock is keeping 'sun time,' because solar days are not of uniform length, as the clock days are, being longer at perihelion and shorter at aphelion. And this difference, very seldom thought of, perhaps even ignored in our teaching, may be illustrated and made plain by actual measurement with the Sun Board.

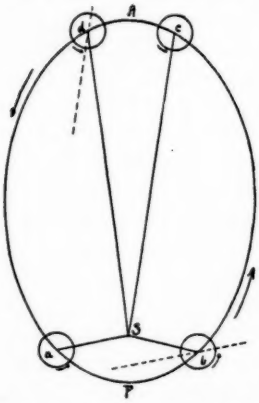
4. *To Make a Graphic Construction of the Time Equation: The Analemma.* The period of the earth's rotation is about the most perfect

unit of time measurement known. To measure the length of this period one must take a base of reference on some object outside of the earth. And here trouble begins, for a dual opportunity of reference presents itself; we may refer to a star, taking the period between two successive appearances of this star in our meridian, and we have what is called the "sidereal day," a period which is uniform, day after day thru the year. This is the real basis of our system of time. But the determination of this day is difficult to the ordinary observer, tho a relatively simple matter in the astronomical observatory. The other method of measuring the period of rotation is most obvious, but gives a variable result, and lays us liable to serious difficulties in the time measurement; this method takes the sun as the extra-terrestrial point to which the earth's rotation is to be referred. The period intervening between two successive crossings of our meridian by the sun, is the solar day, and its very obviousness has forced it upon us as the ordinary unit of time measurement. But the length of this period is quite variable thru the year, being longer in our winter and shorter in our summer. Now it is in the nature of our clocks to keep a uniform rate of time, and we should have to be setting our clock every day in the year, sometimes slower, sometimes faster, to keep it with the sun. This on the face of it would be intolerable, and the easiest solution of the difficulty is the adoptation of an *average,* or *mean solar day*. This is the period which, subdivided, gives us the hour, minute and second. The year, and all other duration is measured in this unit or its derivatives.

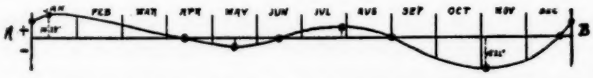
The graphic illustration of the difference between the sidereal day and the solar day, will make it easy to understand the difference between the solar day and the mean solar day. If an observer A, starts say Jan. 6, with the instant the sun is in his meridian, s-s, to measure one earth's rotation, he will have passed thru 360° of arc, when he has arrived at position A in the plane S′-S′ on Jan. 7. This is the measure of the sidereal day, the star being so far away that its rays are practically parallel at all parts of the earth's orbit. In the diagram this is shown, by making S′-S′ of Jan. 7 parallel with S-S of Jan. 6. But the observer at A on Jan. 7 is not yet at noon, because in the one rotation the earth has traveled forward in its orbit about one degree, represented in the drawing by S′OS, and the observer



must travel on over the arc A A′, before he has the sun again in his meridian. This longer arc, which as we see, is about 361° of rotation, is the solar day. Now if the earth's orbit were a circle, and its rate of travel in this orbit were uniform, this longer arc would be uniform, day by day, and would give us as uniform a period as the sidereal day. Under these conditions a clock running with a uniform rate might be set by the sun, and stay with it all the year. But the earth's orbit is an ellipse, and the earth, for six months, from aphelion (A) to perihelion (P), is a falling body, coming closer and closer to the sun, and increasing its linear velocity as a consequence. So that in a unit of time, it passes over a considerably longer arc and larger angle in the region of the perihelion, (*e. g.* aPb) than it does six months later, at aphelion, (cAd). Thus in a sidereal day at perihelion a longer arc of orbit is passed over, and a larger increment of time must be added by the observer to bring him to his meridian, than is the case at the aphelion. Thus in the perihelion part of the year the clock noon arrives before the sun crosses the meridian, and the sun is said to be 'slow.' Again at aphelion the mean solar day is a little longer than the actual time between meridian transits of the sun, and the sun comes to his meridian before the noon of the clock, and the sun is said to be 'fast.' A little consideration will show that the mean solar day must be a trifle longer than the shortest solar days at aphelion, and somewhat shorter than the longest solar days at perihelion. Thus there will be four times in the year at which the sun will coincide with the clock, being alternately faster and slower than the clock in the intervals. To establish this relationship we have the time equation. To observe it and chart it graphically is our present problem.



With the Sun Board in place, *i. e.* the scaled diameter accurately in the meridian, take the time at which the shadow of the plumb line lies in the meridian. Set down this reading as so many seconds or minutes before, or after the clock noon, as the case may be. Take as many readings as possible



thruout the year, and enter them in a graph, as follows: Draw a right

line AB which shall stand as the earth's orbit, making it 365¼ units long, for the days of the year. This line may be laid off on cross ruled paper, and the months with their days indicated. Then enter each observation at its proper day, as a line at right angles to this base line, with a value expressed in convenient units; for example giving the ordinate of sun's error a value equal to the space covered by five days on the year line. Let all 'sun fast' observations be "+" and entered above the line, and all 'sun slow' observations "—" and entered below the line. When the year's record is complete, connect the termini of all these sun's error lines with a smooth curve. The dates of the intersection of this curve with the line A-B, are the dates when the sun time and clock time coincide. These dates are about April 14, June 15, Sept. 1, and Dec. 25.

The observations for this study may be made any convenient day, and the sun's error entered for the record, tho one would wish to have more frequent observations at the time of the sun's maximum departure from the clock time.

The time equation is sometimes graphically shown in the form of a figure 8, called an analemma, which one may see and study, on a good globe.

So far in this problem we have assumed that the clock was keeping local time. But many people, perhaps most people in America do not now set their clocks by the sun. They keep standard time instead. Of course for all people living on a standard time meridian the above instructions apply, because standard time for them is their own local time. But if the observer live at one side of the standard time meridian, there is a correction for his longitude to be remembered and applied. This leads us to the next problem:—

5. *To measure the difference between local or sun time, and standard time.* Install the Sun Board in the true meridian. Rotate the movable horizon, bringing its scaled diameter into the meridian, with the plumb line at the south point. The sun now will cross the meridian when the shadow of the plumb line falls in this diameter. If, now, the clock or watch used has the correct standard time, the observer will note carefully the exact time the sun crosses the meridian. Let us suppose the observer to be at Green Bay, Wis., and that he makes the observation on Jan. 10. He finds that the shadow of the plumb line falls in the meridian at eleven o'clock 23 minutes and 32 seconds: that is, 36 minutes 28 seconds before the noon of standard time. Referring now to the time equation he finds the sun on Jan. 10, 14 minutes 28 seconds fast. Subtracting this 14 minutes 28 seconds from 36 minutes 28 seconds leaves us 12 minutes, a difference which standard time brings to the reading. Since this 12 minutes shows the clock

to be slow, the observer may know that he is east of the meridian from which his standard time is reckoned. And since one degree of longitude is equal to 4 minutes of time, dividing this time difference by 4 will give him his longitude difference; 12÷4 equals 3° and 3° from 90° equals 87° west, the observer's longitude.

6 and 7. *To measure the sun's altitude.* Place the Sun Board in its meridian as before, and rotate the inner horizon, so as to face the doorway toward the sun bringing the shadow of the plumb line into the scaled diameter, so establishing the sun's azimuth. The sun will be shining directly into the doorway, and illuminating the scale of degrees making it possible to read the angle of the sun's elevation. This is a very convenient scale for altitudes between 20 and 60 degrees, but for angles higher than 60 the degree spaces are too small and in the nature of the case the angles below 20 cannot be read. An alternative and superior method of taking the sun's altitude is provided in the vertical quadrant behind the doorway. This reads all angles equally well from the horizon to the zenith. The rear edge of the top of the door frame runs thru the center of curvature of the quadrant and the sun shining across this line, casts the shadow of the doorway upon the quadrant. The angle left illuminated reads the sun's altitude. The small size of the instrument gives it a decided advantage in this reading, for the scale where read is only an inch and a half from the top of the door frame which casts the shadow. This reduces to a minimum the error due to diffraction, giving an opportunity to read to an estimated fraction of a degree.

Another way in which the sun's altitude may be studied, is found in the linear measurement of the shadow of a vertical post. The doorway serves the same purpose here, and a scale is provided in inches and twentieths reading from a zero point in the front surface of the doorway. So one may read this shadow length at noon, on random days thru the year, watching it grow very short when the sun is at a high altitude at noon in June, and then increasing in length day by day until its farthest reach on the winter solstice, Dec. 21st.

Another interesting study may be made, of the altitude of the sun, hour by hour through the day. The very rapid change in altitude in morning and evening, and the extremely slight change in altitude during the middle of the day, have a very close relationship to the daily range of temperature, which may be worked out graphically. For the heating power of the sun is a function of the sun's altitude. This special problem is taken up under Problem 9.

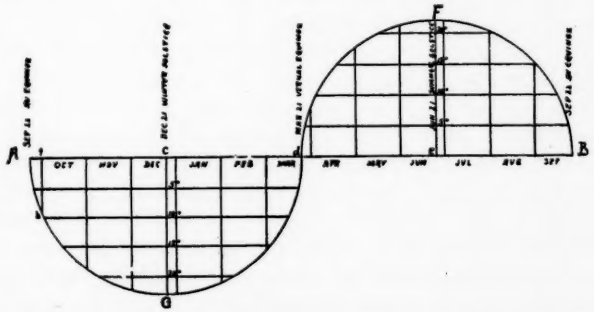
8. *To determine the latitude of the observer.* On the day of the

equinox the sun's vertical ray is on the equator, and the poles have tangent rays. At noon on this day the sun's altitude all over the earth, is the complement of the latitude of the observer. For example, at latitude 30° the sun will have an elevation of 60° at noon; and 90°—60° equals 30°, the observer's latitude. On this day, then, any observer, reading the sun's altitude at noon, may subtract this reading from 90° and have his latitude.

At the other critical dates, the solstices, the problem is also easy. For at the summer solstice the sun's vertical ray is 23½° farther north than at the equinox, so from the sun's altitude at noon, one subtracts 23½°, and then proceeds as before. For the winter solstice one adds the 23½° to the noon elevation before subtracting from 90.

It ought to be noted here that there are two solutions of the problem when the sun's elevation is 66½° or over. For example if the sun's noon altitude is 80°, the solution given above is followed if the sun is on the equatorward side of the observer: 80°—23½° equals 56½°; 90°—56½° equals 43½°, the observer's latitude. But if the sun is on the poleward side of the observer, he must subtract the complement of the sun's noon altitude from 23½° for his latitude. Thus: 90°—80° equals 10°; 23½° —10° equals 13½°, the observer's latitude.

Of course for any intervening day, between equinox and solstice one may consult the ephermeris,, or one of the larger almanacs, and find the altitude which corresponds with a given day. Or one might make his own table by constructing a projection of the path of the vertical ray, making it possible to read directly from this graph, the sun's declination for any day in the year. To construct this graph lay off on a right line a distance A-B which shall be 365 units long, for the days of the year. Di-

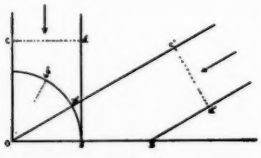


vide this line into quarters. With one quarter as a radius, and with a center at c, strike the semicircle AGd, and with e as a center the semicircle

dFB. This radius cG is then divided into 23½ units beginning at c, and the same with eF beginning at e. These divisions are for the latitude degrees covered by the sun's vertical ray. Thru these degree points lines are now drawn parallel with AB to cut the circumference of the semicircles. Now consider point A the autumn equinox, c the winter solstice, d the spring equinox, e the summer solstice, and B the autumn equinox again, and lay off the calendar on the line AB, showing the days of the month at the day spaces, and drawing ordinates or vertical lines through the day points to cut the semicircumference below or above the line as the case may be. One now reads the sun's declination for a given day, as for example Oct. 1, by reading the degrees indicated on the day's ordinate gh. And in the Northern Hemisphere this reading would be added to the sun's altitude at noon on Oct. 1, before subtracting from 90 to find the observer's latitude.

The year having 365 and *one-fourth* days this construction will not give strictly accurate values, tho they will be quite close enough for purposes of laboratory exercise.

9. *To show the relation between the sun's altitude and its heating power.* Leaving the influence of the atmosphere out of account, the sun's power in the production of heat, varies inversely as the surface covered by a beam of given cross section. This area covered bears a simple relation to the angle of the incident beam. A vertical beam has the maximum efficiency, for here it is concentrated on the smallest possible surface. As the beam is inclined it covers a larger surface, so the unit area receives less energy. For instance, at an elevation of 30° the beam, covering twice the original area, (Fig. 6, OB equals 2OA) will give to the unit surface only one-half the energy which the vertical beam would give. This principle is



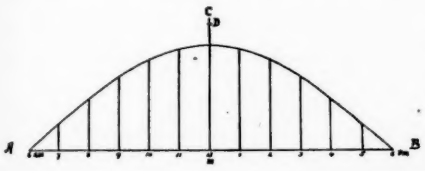
taken advantage of in the beam box of the Sun Board, and the scale provided with it. For this determination the Sun Board may be placed in the sun anywhere, without reference to the meridian, and leveled. Then the horizon is rotated to bring the beam box toward the sun. The beam box is now rotated on its hinge until the two cross wires in the box, which are parallel with the hinge, bring their two shadows into coalescence upon the movable horizon. This assures the proper altitude of the box. Now rotate the horizon until the cross wire in the box which is at right angles with the box hinge, casts a shadow into the scaled diameter on the movable horizon, and the sun's azimuth is found. These two adjustments put the beam box into coincidence with the sun's beam.

The box has a cross section of a square half inch. Running along the en-

graved diameter, is a scale of half inch units, divided into tenths, and reading from a zero in the hinge line of the box. Thus when the box is vertical its inner surface encloses just a square half inch of the horizon. When it is inclined, the sun shining thru it illuminates the movable horizon, and the area covered by the beam can be measured exactly in units and tenths from the part of the scale illuminated.

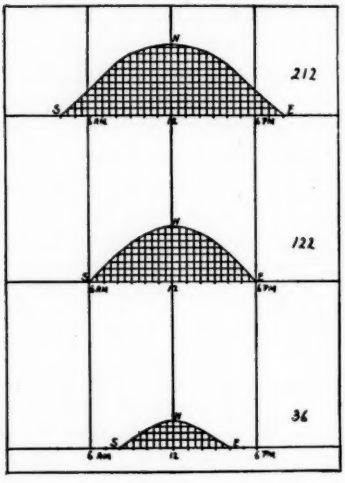
The intensity of insolation is thus read arithmetically in terms of the efficiency of the vertical ray, as the reciprocal of the scale reading. Thus if the beam covers 2 scale units the intensity is 1|2. If it covers three scale units, the intensity is 1|3. If the reading is 1.3 the intensity is 1|1.3 and so on.

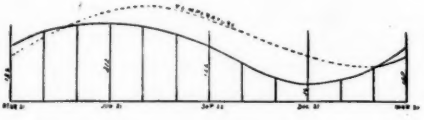
An exercise may now be set to show the heating power of the sun for all the hours of a given day. The readings may be taken with the Sun Board on each even hour, the observations recorded in a table, and the table then converted into a graph as follows:—On the cross ruled paper lay off a line of convenient length, AB, which is divided into equal spaces for the hours of the day. Number the hours each way, from the midpoint, which is 12, noon. On the noon ordinate, (12-C) lay off a convenient unit (12D) for the heating efficiency of the vertical beam. In this unit the insolation of all inclined beams will be expressed as fractions. These fractions, the reciprocals of the scale readings converted into simple or decimal form are the natural sines of the sun's elevation, and are to be laid off each on its respective hour ordinate. Connect these points and the sunrise and sunset points, and we have the graphic record of the insolation for each hour of the day. The area of the figure AEBNA is the sum of the total day's heat receipt, which can be expressed in any convenient unit of area.



It will be an interesting and very valuable exercise, to make such figures for a series of days chosen at critical dates thru the year: For example at summer solstice, equinox, and winter solstice. Fig. 8 shows how three such graphs of heat receipt might look. The comparison between them will be easiest expressed in a common unit of area, say the square of the cross ruled paper, enclosed by the curve (SNE) limiting the reciprocals of the hourly readings. In this case these numbers are 212, 122 and 36. One cannot look at these three graphs without seeing why there is a warm season and a cold season.

Such "daily heat receipt" graphs may be made for various days thru the year, and the area of each expressed in a numeric. These numbers may then be built into a graph which will show very accurately the accumulation of heat of our summer, and the waning heat receipt of winter. On the same paper with the record of heat receipt; we may enter day by day the temperature of the air. The average daily temperature is the best to use for this, tho a reading taken at eight or nine in the morning will serve admirably. This graph puts before our eyes the real proximate cause of the change of season, expressed quantitatively, and accompanied by an actual temperature record of the results of a variable heat receipt.





SOME RESULTS OF SUN OBSERVATION IN THE FOURTH SCHOOL YEAR

"From observation children should be able to conclude: 1. Warmest part of day when sun shines from most directly above by comparing with morning and evening temperature. 2. Warmest season of year when sun rises highest in heavens during daily track by comparing sun's shadow observations. 3. Warmest parts of earth would be where sun shone most directly upon the earth during the year."

THE GEOGRAPHY COURSE IN THE OSWEGO STATE NORMAL AND TRAINING SCHOOL

By AMOS W. FARNHAM
Oswego, N. Y.

PART II

Geography Method

THIS course is pursued two years after the course in subject matter, as outlined in this JOURNAL for February, 1906, has been taken. The time devoted to this phase of the work is five forty-five-minute periods weekly for twelve weeks. The work is outlined in detail below:

A. Analysis of subject matter, noting,—
   1. Causal relations.
   2. Processes of reasoning involved.

B. Reorganization of subject matter with a view to teaching it, organization determined by,—
   1. Children's present development.
   2. Children's interests, habits of thinking, and necessities.

   Note.—Logical and pedagogical arrangement of subject matter distinguished.

C. A consideration of the use of the reference library, illustrative material, and apparatus: raw and manufactured products, models, pictures (lantern slides especially), text-books, globes, maps, etc., with practical illustrations.

D. A discussion of the value of excursions to the fields, to shops, to local industries, etc., and how such excursions may be made with classes of children.

E. A study of the relation of geography to other subjects of the course, noting that geography is a basis for correlation.

F. Talks given by members of the class in practice, in which they outline their work so far as they have gone with it, stating difficulties met and how overcome; at the same time exhibiting material and apparatus used, and stating how used. These talks are found to be valuable not only to the method class, but to the members of the practice class as well.

G. Making of lesson plans, stating for each particular lesson,—
   1. The aim.
   2. The preparation.
   3. The presentation.
   4. Minor and major summaries.

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H. Observation in the school of practice during the last week of method course. During "observation week" the members of the incoming class observe the children assigned to them, studying methods of teaching and discipline, also noting the order of receiving and excusing classes, the order of passing material, and other mechanical devices which save time and tend to promote good order.

PART III

Practice Teaching

This part of the geography course is taken during the term (twenty weeks) immediately following the method work. Outlines of all lessons are submitted to the supervisor of geography for correction, suggestion or approval. The supervisor visits each class one or more times each week and then expresses his judgment regarding the work, either orally or in writing, to the respective practice teachers. He holds a geography conference weekly, at which time questions of general interest to geography teachers are discussed.

The geography work in the school of practice begins with the fourth year above the kindergarten, and is usually finished the first half of the ninth year. It is quite fully outlined so that each teacher may know its scope; therefore may know what precedes and what follows the work of her grade and hence the relation of her part to the whole.

The Work of the Grades

Fourth Grade: Home Geography and the World as a Whole.

Home Geography.

The very first step in a knowledge of geography is to know thoroughly the district where we live.—*Ritter.*

Immediate environment—The city (Oswego).

Note.—Accepting the definition, "Geography is the study of the earth in its relation to man," there are three elements to be considered, *earth, man* and their *relation.* Two of these, earth and man, are concrete; the remaining one, relation, is abstract. Some knowledge of the concrete elements must be gained before any knowledge of the abstract element can be gained. Of the concrete elements, man (his activities) appeals most strongly to the child. Hence begin with the human element.

A. The people (of Oswego).

Children led to state that an unusually large number of persons is seen on the streets a little before seven in the morning and just after six at night. They are going to and from their work. Children name all

places where their relatives and friends work, and then make the following classifications:

I. Where the people work: In factories, stores, offices, banks, at trades, on boats, in their homes, in school, and in church organizations.

II. Why the people work: To procure food, clothing, shelter, fuel, lights, furniture and furnishings, papers, magazines, books, to hear lectures, to have church privileges, to provide for sickness, old age, and to pay taxes.

Summary: The people work to procure the materials necessary to satisfy the needs of their bodies and of their minds. Their needs are many, therefore it is necessary to have many kinds of work to satisfy them.

III. How the people go to and from their work: Most of them walk, some ride on bicycles, some in street cars, some in steam cars, some in their carriages, a few ride occasionally in hacks, and a very few ride in automobiles. Note which means requires least time and which most; which least effort, which most; which greatest expenditure of money, which least. Then which is used by the largest number of people?

IV. How the people communicate with each other: Usually by word of mouth. Sometimes by messenger. Often by telephone. Occasionally by telegraph. Now and then by mail. Which way incurs least expense? Which least time? Under what circumstances is each generally used?

B. The streets (of Oswego). Earth element.

I. The use of streets: Common thoroughfares for the people.

II. Need of many streets: To accommodate many people, shorten distances, prevent trespass.

III. Need of broad streets: To facilitate traffic, prevent accidents.

IV. Need of paved streets: Greater ease for draft animals, larger loads may be drawn, contribute to health and beauty.

V. Need of lighted streets: Fewer occasions for accidents, fewer opportunities for crime.

VI. Need of clean streets: Hygienic and aesthetic values. Who may help to keep streets clean? how?

VII. Need of shaded streets: Trees make streets cooler in summer, break the force of storms in winter, furnish homes for the birds and make the city more beautiful.

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VIII. Need of street drainage: Hygienic, commercial, and aesthetic values.

Note.—Show pictures of local streets, also of streets of other cities. Pictures of familiar scenes put content into pictures of related unfamiliar scenes, thus giving them reality and making them more than mere pictures.

C. The buildings (of Oswego).

I. Factories mostly on the river: Waterpower and commercial highway. (The canal merges in the river.)

II. Stores on streets near the river: Located to accommodate the people. It is the tendency of business to centralize.

III. Banks near stores and factories: For safe keeping of moneys; for issuing and cashing commercial papers.

IV. Dwelling houses on nearly all streets: Located to accommodate their occupants. Where are they nearest together? Where are most vacant lots?

V. School houses located to accommodate the children: Near enough together to prevent the ills of over-crowding, also to prevent discomfort from long walks in unfavorable weather.

VI. Churches located away from business: To avoid distracting noises.

VII. Post office, telephone, telegraph, and express offices central: To accommodate the business men of the city.

VIII. Railroad stations away from dwellings, etc.: To save the people from noise, dust, and danger.

Show pictures of local buildings, children tell on which streets these buildings are located, and then name any friends of theirs who may be employed in any one of them.

Show pictures of similar corresponding buildings in other places.

D. The great needs of the people:

I. Houses to shelter their homes.

1. Lumber.

a. From lumber yard; location.

b. From lumber region; location.

c. Transportation from lumber region.

d. Transportation from lumber yard.

2. Carpenters.

Note.—Similar for brick and stone for building, and for masons to do the work.

II. Furnishings: Kinds, source, transportation.

III. Food: Vegetables, fruits, meats, eggs, bread, milk, cream, butter, cheese. Lead children to make the classifications, to name the sources of the different kinds of foods, and state how they are brought to us. Children name their grocer and give location of his store.

IV. Fuel for cooking food and warming houses.
Kinds: Coal, coke, wood, gas, kerosene. Source of each. How brought to us? Specimens of coke and different kinds of coal presented to class to be identified and named. Which kind of fuel is used most in summer? Why? Which in winter? Why? Which kind of fuel is cheapest? Which requires least time and attention? Which contaminates the air of the room most and exhausts it soonest? Show that the earth either directly or indirectly supplies all our fuel.

V. Clothing. Kinds: Woolen, cotton, silk, linen, leather, rubber. Name clothing of each kind seen in schoolroom. Specimens of raw material shown to class. Sources of raw material. What kinds come from the plant world? What kinds from the animal world? When do we most need woolen garments? When most need cotton? When rubber?

VI. Lights for our homes.
Kinds: Oil, candles, gas, electricity.
Source of each. Which is cheapest? safest? cleanest? most hygienic?

VII. Water supply. Source: Importance of pure water.

VIII. Means of travel and transportation: Wagons, sleighs, bicycles, automobiles, street cars, steam cars, canal boats, vessels. For what purpose is each kind most used? What kinds are not usable in summer? What kinds are not usable in winter? Which have been longest in use? Which have been recently introduced? Show pictures of colonial pleasure wagons, of horse cars, of "packets" on the Erie Canal, and of early railroad coaches and the "Empire State Express."

E. Surface features of the city (Oswego).

I. Hills: Location with reference to the (Oswego) river and the lake (Ontario).
Normal Hill studied in detail: Its slopes: their number, direction of slopes, uses, comparative lengths, comparative steepness, relation of each to drainage and insolation. Water-partings found and defined. Children name streets that extend up and

down the slopes, also those that extend across. Desirability of homes on slopes. Why? Normal Hill modeled in sand and outlined on blackboard.

II. Plains: Location with reference to the river, lake, and hills. Uses. Streets that cross plains north and south, east and west. Desirability of homes on plains. Why?

III. Hills and plains compared:
In height, extent, drainage, moisture in soil, fertility, healthfulness, beauty of outlook, relation to river and lake, desirability for residence.

IV. Oswego River: Location with reference to the city; direction of flow and why? means of crossing (number of bridges, use of each, how crossed before bridges were built—in summer, in winter). Pictures of noted bridges shown, comparisons made. Mouth of river, the harbor. Uses of the river: Waterpower, water supply, commercial and aesthetic values.

V. Lake Ontario: Location, uses.

F. Industries: Attention is called to the leading industries of the city, and those nearest the practice school are studied in detail. The Box Shop, Diamond Match Factory, National Railway Steel Spring works, Kingsford's Boiler Works, Oswego Starch Factory, Conde's Knitting Factory, Ames' Iron Works, Dairy Supply Plant, Chemical Cold Storage. Excursions when possible.

I. Detailed study of the Diamond Match Factory.

1. Location with reference to Normal School building and the lake.
2. Articles manufactured. (A box of Diamond Matches in class.)
   a. For what purpose?
   b. What was used before matches? By civilized people? By Indians?
   c. Benefits derived from the invention of matches.
3. What materials are used?
   a. Where obtained?
   b. How brought here?
4. Where are the matches shipped for sale?
5. Number of men, women, boys, and girls employed. Importance of this industry to Oswego.

G. The adjacent country.
Note.—Note the location of country with reference to city, the streets

that lead to the country, means of conveyance, different ways of reaching the country, and different means of communication.

I. The people.

1. What they do in spring:
   a. Trim fruit trees. Why?
   b. Make maple sugar.
   c. Mend fences thrown down by winter winds and frosts.
   d. Prepare the soil for crops; by plowing to make the soil deep; harrowing to make it fine; fertilizing to make it rich; ditching to make it sufficiently dry. Illustrative material: Pictures of a sugar camp and of sugar making. Pictures of farm implements which may be obtained from the manufacturers for the asking.
   e. Plant potatoes, corn, pumpkin seeds.
   f. Sow wheat, rye, oats, barley, garden seeds.
   g. Make and sell butter and cheese. An excursion to the plant of the Dairy Supply Company. Specimens of the different grains, thrashed and unthrashed, shown to class. Show pictures of farm industries.
2. What they do in summer.
   a. Cultivate crops: by plowing to loosen the soil and kill weeds; by hoeing to give the roots a greater depth.
   b. Pick and sell small fruits.
   c. Harvest hay and grain; thrash grain, sow buckwheat.
   d. Make and sell butter and cheese.
   e. Raise poultry.
   Use specimens and pictures.
3. What they do in autumn.
   a. Harvest the remaining crops: grains, root crops, garden vegetables, fruits.
   b. Make and sell cider.
   c. Market hay, grain, and fruit.
   d. House the farming implements. Why?
   e. Make and sell butter and cheese.
   f. Sell poultry (Thanksgiving).
   Excursion to Chemical Cold Storage.
4. What they do in winter.
   a. Care for the stock.
   b. Prepare fuel (wood).
   c. Market hay, potatoes, cabbage, butter, poultry.

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Children should be led to see that the farm work changes as the seasons change. This work underlies the study of climate and climatic effects on life.

H. Dependence of the city people upon the country.
   I. For food for ourselves: vegetables, fruits, grains, meats, dairy products, eggs, maple sugar and maple syrup, and honey.
   II. For food for our animals: fodder and grain.

I. Dependence of the country people upon the city.
   I. Market for their products.
   II. For articles which they cannot produce; such as tea, coffee, rice. Why?

J. Advantages which cannot be had in the city.

K. Advantages which cannot be had in the country.

THE WORLD AS A WHOLE

After home geography, the study of the children's environment, a series of lessons on the world as a whole is given to teach (a) the shape of the earth; (b) that the shape of the earth in part determines the hot, temperate, and cold belts; and (c) that every region studied may have its proper world setting as well as its local setting.

A large globe, the larger the better, for class use, and small globes for individual use, are indispensable. The children's home (Oswego), the Oswego River, and Lake Ontario are located first, care having been taken to have the globe so placed that the north pole points north. The first region studied is Alaska. Reasons: It is far north and therefore has a cold climate; the aborigines live primitive lives which appeal to the children; it is a part of our continent, and is under our flag.

A. Alaska. Work introduced by a consideration of seal-skin.
   I. Seal-skin.
      1. Show some article of seal-skin.
         a. Children tell what things are made of seal-skin. Show pictures of seals. Note their geographical environment. Let children determine the weather and state what season of ours it is most like. Teacher says that where the seals live snow and ice are found throughout the year. Location of region from which seal-skin is obtained. This region is called Alaska. Direction of Alaska from Oswego. Children point and walk in this direction.
         b. Story of seal fisheries told by teacher, reproduced by children orally and in writing.

2. Climate of Alaska. Compared with climate of Oswego.
3. Plant life: Kinds, quantity, quality. Compared with plant life of Oswego.
4. Animal life: Kinds, their food.
   N. B.—Throughout the work lead children to compare the new with the related old.
5. People. Show picture of Eskimos.
   a. Their houses: materials, plan.
   b. Their food: kinds, how procured.
   c. Their clothing: material, source, styles.
   d. Their fuel: material, source.
   e. Their lights: what used.
   f. Their means of travel: snow shoes, boats, dog sledges, reindeer sledges.
   g. Comparative distance of their home from ours.
   h. How and by what routes are seal-skins brought to us. Time required.

   Use pictures and blackboard drawings freely.

   Read Jane Andrews' story of Agoonack, in Seven Little Sisters.

   Note.—Further work on Alaskan products may include,—

II. Gold. Show some article of gold, preferably a gold coin. Children tell what other things are made of gold. Show pictures of the mining regions. Story of perils and hardships incident to a journey to these gold fields. How gold is brought from Alaska to San Francisco and what is done with it.

III. Salmon, salmon fisheries, Yukon River (locate on globe). Material used: Picture of salmon, unopened can of Yukon River Salmon, pictures of various stages of the industry. Story of the salmon fisheries reproduced orally and in writing.

Tell children that Alaska is a part of our own country; that we bought it thirty-nine years ago, and paid a great amount of gold money for it. ($7,200,000. Purchased of Russia in 1867.)

Summary of work on Alaska in lecture room with lantern slides.

Children have learned that the average weather of peninsular Alaska is similar to the average winter weather of Oswego. They have seen the effects of such weather on plant life, animal life, and on human activities

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and human development. The rigors of the climate have kept the race in its infancy, and reduced life to mere existence. Their primitive ways of doing things are of greater interest to children than are the most intelligent ways of a civilized people. The Eskimo's hut, clothing, and reindeer sledge are more attractive than the banker's residence, Parisian costumes, and the "Southwestern Limited."

We next introduce the study of Mexico, whose narrow coastal plain has continuous weather similar to the hot summer weather of Oswego.

B. Mexico. Work introduced by a consideration of coffee.

I. Coffee. Show sample of unroasted coffee, also of roasted and ground. Uses of coffee. Show pictures of coffee trees, a coffee plantation, coffee culture in Mexico. Children note the geographical environment, decide the kind of weather, and when we have similar weather. Teacher states that where coffee grows it is warm all the year round. One place where coffee grows is Mexico.

1. Location of Mexico on globe. Direction from Oswego.
2. Story of coffee culture; reproduced by children.
3. Climate of Mexico: Coastal plain where coffee grows.
4. Plant life: Kinds, quality, quantity.
   Emphasize plants peculiar to the region. Compare with plant life of Oswego and with plant life of Alaska. Account for difference.
5. Animal life: Kinds peculiar to the region. Show pictures. Their food. Their use to the people. Compare with animal life of Oswego and Alaska. Reasons for differences.
6. People: Show pictures of Mexican Indians and of the upper classes; of the houses of the different races, note material and plan of each. Consider peculiar food, styles of dress, means of travel.
7. Locate Vera Cruz on globe. Compare with Oswego with reference to location, size, age, etc.
8. How may coffee be brought from Vera Cruz to New York, and from New York to Oswego? Routes traced on globe. Time required for transportation.
9. Directions and distances of Mexico and Alaska from Oswego compared. Children point and walk in each direction.

Study of Mexico may be continued by considering,—

II. Vanilla, vanilla culture, uses.

III. Mexican hammocks, material used, uses.

Summary of work on Mexico in lecture room with lantern slides.

After Alaska and Mexico have been studied, take up,—

C. Valley of the Amazon: India rubber, Brazil nuts.

D. La Plata Valley: Leather, wool.

N. B.—Children have found a cold region far north of us, and a hot region far south. Now they discover that south of the hot region is a region similar in climate to our own.

E. Siberia. Furs: Sable, otter, ermine. Children note location of Siberia with reference to location of Alaska. Trace on globe from Siberia to Alaska and, in same direction, from Alaska to Siberia. Note that similar climate prevails. Hence a cold belt in the far north encircling the earth.

F. Switzerland: Cheese, music boxes, Swiss carving.

G. France: Silk.

H. Spain: Cork, olives.

I. China: Tea, fans, fire crackers.

Children note location of Switzerland, France, Spain, and China with reference to their own home. Trace on globe and discover that a temperate belt south of the cold belt encircles the earth.

J. Central Africa: Ivory. Compare the location of Central Africa with location of Amazon Valley. Trace the hot belt that encircles the earth.

K. South Africa: Diamonds. Compare location of South Africa and La Plata Valley, and trace the south temperate belt that encircles the earth.

South of the south temperate belt is a cold belt similar to the cold belt which includes Siberia and Alaska, but this cold belt has but little land, and no people.

Note.—In the study of the world as a whole, emphasize the geographical elements, notably climate, its effects on plant life, animal life, and human industries. Consider transportation routes, means of transportation in different countries, the commercial cities and sea ports. The work of comparison should be frequent and thorough.

(To be concluded)

GEOGRAPHY AND LIFE

By W. J. SUTHERLAND
State Normal School, Macomb, Illinois

THE leading consideration concerning all life is self perpetuation. The inalienable right to live is the most impressive thought revealed in nature. Dearness of life is the sole cause of the universal conflict in the organic world. A superficial glance at nature reflects the harmony and tranquility of a "daisied field in June," but a more careful scrutiny convinces us that the realm of nature is the scene of a warfare "utterly shameless and utterly cruel." "Long life and length of days" come only to the creature whose environment is favorable to its needs. Either organisms find desirable homes and congenial company, or vanish from the earth altogether. The security of life is contingent upon environment. The interesting adaptations of plants to secure sunlight, water, and food; and of animals to secure food, and for rivalry and defence, establish the fact that dependence characterizes every organism by determining its nature.

Animals derive food either directly or indirectly from plants, for they alone possess the important function of organizing inorganic materials. Since the two kingdoms must occupy the same dominion, the struggle for existence is made more intense. But plants, in turn, are dependent upon proper conditions of temperature, moisture, and soils. The temperature of any region leads to a consideration of the sun and its effect upon earth and atmosphere; moisture takes into account the aqueous envelope as affected by heat and winds; and soils result from the combined action of all these factors and forces upon the rock crust of the earth. Plants do not thrive in regions where the temperature remains long at or below 32°, as water is necessary to dissolve and transport nourishment. A meager precipitation of moisture, for a similar reason, stunts plant growth; but with sufficient moisture and a high temperature, there is scarce a region in the world that would not "blossom as the rose."

A consideration of man's distribution and development reveals positive evidence of his response to physiographic conditions. Temperature and moisture are chief among these, not only because they affect him directly, but because they determine the productiveness of habitable areas. The progress of civilization leads to the conclusions (1) that range and variation in climatic conditions are favorable to civilization and culture, and (2) that extreme and uniform conditions are unfavorable to the advancement of civilization.

Tropical regions support a luxuriant vegetation in response to high temperature, liberal rainfall and alluvial soils. The food supply is generous and were it not for other less favorable conditions a dense population might flourish. The range of temperature is scarcely more than ten degrees, and, in addition to the enervating influence upon human beings, it permits an uninterrupted plant growth, insuring abundant food with but little expense of human energy. The rank vegetation becomes a barrier which man declines to penetrate, partly because intertwining plants and vines obstruct his path, and partly because this tropical verdure harbors a dreaded animal and insect life. Resistance to life, so far as food and shelter are concerned, is reduced to the minimum; the palm alone may furnish all that human life demands for mere subsistence. Excessive heat causes man to languish in the shade; excessive moisture breeds disease and makes cultivation difficult. The uniform climate and unlimited varieties in vegetation become monotonous and oppressive. Plant life holds the scepter! Man is over-awed with the fierceness and regularity of environing conditions. Long subjection has brought with it resignation and mental decadence. What wonder that the infantile mind should reverence forces so irresistible as scorching suns, angry skies, gigantic trees and ferocious beasts! What wonder that man should abandon a struggle for supremacy in which the odds are so against him!

Civilization is also in a low stage in the Arctic Regions. The Eskimo's struggle for existence is so intense that all human effort is expended in extorting from nature a meager support. If we reflect on the conditions of his environment, we shall discover the most depressing monotony: the long silent night with only lurid gleams of light; the illimitable expanse of glacier ice; the absence of vegetation; the desolate climate; the few species of animal life; surely, his is a "universe of sky and snow." Here, again, nature outbalances man, and ambition is weighed down by conditions so monotonous, that no excitations appeal to him except those for food and shelter. Even the food that he eats so lacks variety that the building up of a sensitive and susceptible organism is impossible. He is as stolid as the world in which he dwells. Being driven for long periods to his home by the rigors of the clime, his emotional nature responds to enforced retirement and hence he manifests a strong love for home and family. Surely his is a case of arrested development; growth in intelligence demands at least some surplus energy after a mere livelihood is insured.

Temperate regions are characterized by a great range of temperature and a varying supply of moisture. A rigorous climate demands well built homes and warm clothing; short summers demand great activity in order

to mature crops; indigenous food-plants do not abound; soils produce only when carefully cultivated; woods are relatively scarce; metals are abundant but often difficult to obtain; and mountain barriers frequently separate productive areas. The variety of influences in environment demands versatile and symmetrical development. Even sudden weather-changes stimulate mind and body. Life becomes abundant only when it establishes many relations. Intellectual life is quickened in the consideration of that which is economical and advantageous. Rivalry and competition make life strenuous. Just as the equable temperature of the Tropics minimizes man's needs and leads to responses that are uniform, so the temperate realm multiplies the necessities of life and brings a variety of responses. The high temperature of summer, following a severe winter, is a powerful stimulant, and the reactions which lessen the tension come in the form of linen clothing, electric fans, manufactured ice, open cars, railroads to mountain retreats and seaside resorts. So millions of men are busy because the sun has mounted higher in the heavens.

According to Herbert Spencer life is the process of establishing an equilibrium with environment. The more intricate and complex the equilibrial processes become, the higher the degree of life and the higher the scale of civilization. In low forms of life the adjustments to environment are simple, and the accommodations are largely effected by the organisms themselves. Every animal must respond to the demands for food and protection from enemies, or become extinct. The tropical inhabitant adjusts himself to his surroundings almost completely; he lives in caves or in the shelter of trees, wears little clothing and subsists on fruits, roots and insects. He is a direct response to an equable climate and a highly productive soil abounding with indigenous food-plants. Provision for the future is unnecessary, hence irresponsive and indolent habits are consequent reactions. Inactivity and stupidity are direct responses to conditions that make life easy. So nature, here violent and monotonous, outbalances a manhood that places little value upon an existence that is so generously bestowed.

Re-creation of environment is the test of enlightened civilization. In the lower stages of civilization, man stooped to adjust himself to nature and so became enslaved; but in highly civilized races, men have developed tastes and needs which nature, alone, cannot satisfy. So human ingenuity and discovery are summoned to transform material resources, and the work of nature is consummated with an artificial touch, which makes it serve more perfectly, a fastidious people. All arts and industries, all crafts and trades have, in the end, a single function to perform; viz., the promotion of natural resources to greater usefulness. But all modifications of material

resources demand an intellectual alertness which marks progress in civilization.

It is interesting to trace out the history of localized industries, and one is soon convinced that favorable productive conditions coupled with advantageous means of distribution, are the determining factors. To one who has studied geography aright, it is unnecessary to explain why cranberries are grown on Cape Cod, tobacco in the Red Sandstone Valley of the Connecticut, rice in South Carolina, or wheat in Minnesota; or why locomotives are made in Philadelphia, plate glass in Pittsburgh, furniture in Grand Rapids, cotton goods in Birmingham, or pottery in Trenton. Suffice it to say, that industries slowly but surely spring up in the regions well suited to their development. Frequently, where conditions are adverse, men triumph over nature's barriers to civilization, as when they tunnel mountains, connect oceans with watery threads, turn the course of rivers and moisten arid lands. Nature deals out her wealth with moderation in temperate zones and to them only who would "subdue and have dominion" over her. Life is dear because it has been purchased by incessant toil, and it is versatile and abundant because, in the struggle, it acquired knowledge, sympathy, judgment and mercy.

The trend of industrial history is determined by physiographic conditions. Man can modify his environment but he cannot annihilate it. In general, prosperity is coincident with a wise adjustment to geographic conditions. Chief among these are climate and soils of which much has been said. But land forms, themselves, exert important controls over industrial life. A general distribution of mountain ranges parallel to seas makes narrow coastal plains; close parallel ranges enclose inter-montane valleys; in the midst of the sea, volcanic disturbances project habitable lands; the subsidence of continental margins is responsible for numerous head lands and adjacent islands; and great rivers build and moisten far-reaching food plains. Hence it is that these earth processes fashion restricted habitable areas, while unrestricted areas result from the evaporation of large water bodies, or from the diastrophic tilting or lifting of extensive sea-floors. Broadly speaking, habitable lands are restricted or unrestricted and a review of industrial life makes the following inductions possible: (1) Restricted habitable areas determine industries in which a maximum of labor is expended in the production of a minimum of material. (2) Conversely, unrestricted habitable areas determine industries in which a minimum of labor is expended in the production of a maximum of material.

The operation of this principle is reflected in the character of the people. The Norwegians, hemmed in between the mountains and the ocean, were

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long dependent upon the fishing industry, and years at sea developed them into the boldest and most famous of seamen.

When a yard of Belgian hand-made point-lace is sold, ninety-five per cent. of the purchase price is for labor; the value of the raw material used is insignificant. In order that nearly five hundred people may live on a square mile, the highest possible utility must be given every production, by the expenditure of much labor upon little material. In Switzerland, where metals and woods are scarce, hand-made watches and ingeniously carved toys illustrate how a dearth of material may be transformed into great wealth through the application of much industry. Unusual skill, strict economy, and extreme perseverance are the characteristic responses in the people. Restricted tillable areas near Boston and New York stimulate truck-farming because an acre so employed furnishes a maximum of labor, the compensation for which comes when a limited quantity of choice seasonable vegetables finds a ready market.

Not only to industrial life does the principle relating to restricted areas apply, it extends also to political history with most decisive results. As England's tillable lands are much restricted, her own soils have long been unable to support her rapidly increasing population. In 1815 the Corn Law was passed to protect the English landlord. Under this obnoxious measure, the price of wheat in 1817 reached $3.25 a bushel, and the same year the weekly wage of a weaver was $1.02. The struggle for free trade soon followed. The exorbitant price of wheat added to the misery of the under-fed laborer, and the tariff interfered with commerce. Manufacturers demanded free trade because they saw clearly that a more abundant food supply would increase the spirit and efficiency of the workmen, and would also tend to keep labor cheap. Had England's territory been sufficient to furnish food for her millions, the great political struggle that wrenched the very life of England, might have been averted. The misery, suffering, and abject poverty of the people enlisted the sympathy of noble hearts, who condemned a policy that caused "wealth to accumulate and men decay." Poets, reformers, and statesmen championed the cause of suffering humanity, and finally in 1846, Robert Peel through motives altruistic, or otherwise, deserted the Tories and introduced the bill which sealed the doom of the Corn Law and marked the beginning of free trade of England. So in America, geography is peculiarly interwoven with history. The coastal plains, with their rich soils and warm moist climate, must answer for the Civil war, says Prof. Davis, for these conditions made slavery profitable. Ultimately, the economic resources of the South are responsible for the direful social and industrial situations of the present day.

In areas where the resources are unrestricted, the industrial problem is very different. In contrast to the Swiss, who makes a few ounces of metal into a watch worth ten dollars, or the Belgian, who converts a handful of flax into a yard of point-lace worth its weight in gold, the Pennsylvanian makes from his unrestricted resources, iron and coal, locomotives and steel rails. The problem of the Illinois farmer is the production of a maximum yield with the minimum investment of labor. A load of corn which brings $25, shows at least a return of $20 for material and the balance for labor. Dealing, as he does, with produce in great bulk, he becomes wasteful and extravagant. If, instead of Illinois' eighty people to the square mile, it had Belgium's four hundred and ninety, no longer could "half a tillage stint" our prairie plains. No half-cultivated farms, no weedy fence corners, no peaty swamps or alkaline tracts could exist. Agriculture in the past has been easy. Owing to its great possibilities, "man has had only to tickle the soil with the plow and it has laughed with a harvest." But in his greed to get bountiful returns, with little outlay of labor and capital, man is fast reaching a point of limiting returns. Because of reduced fertility, a point is reached at which a given outlay of labor and capital, fails to produce a proportionate yield. Here the study of geography touches life most directly! It is only through an understanding of soils, and a knowledge of the treatment by which their fertility can be maintained, that this point of limiting returns can be pushed farther into the future. So the agricultural college becomes a necessity, and the calling of the scientist is dignified by his reduction of "farming" to scientific agriculture.

Has too much been said concerning the influence of *geography* upon life, and too little concerning the *value* of the *study* of geography as presented in our schools? The educational tendency is emphatically toward a training that touches life in practical, rational, and vital ways; hence the value of any study must be measured by its contribution to fulness of life. That man is best educated who best understands his environments, who most clearly recognizes his relationships and responsibilities to all other life, and who best uses his resources to promote the common weal. Every science deals with some phase of man's environment, and geography, which is a department of science, deals in a general way with the same subject-matter. Any study which aids in giving man the correct view of his place in nature is of great value either from the practical or the cultural point of view; for, indeed, culture to be worthy the name, must manifest itself in the everyday life of a people.

The revelation of truth is one of the chief functions of all education. Superstition and tradition have ever blocked progress. Geography has

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assumed its share in the task of disseminating knowledge. A Genoese visionary, starting out to prove the rotundity of the earth, discovered a new world; Magellan consummated the unfinished task of circumnavigating the globe; the next great triumph of truth came in the middle of the sixteenth century, when Nicholas Copernicus bequeathed to science a solar system. With the contributions of Herschel, Laplace, Ritter, and Guyot, we might think the work of geography complete. But again comes the question more pointed and specific: "How can I, at the country cross-roads, influence life and character through Geography?" Seek the answer in this: shall men and women of the next generation be filled with "wisdom and understanding"; and shall they be free from the bondage of superstitions that distort and terrify life, then must the children of to-day be convinced that moons neither help nor hinder the growth of plants, nor affect the amount of rainfall; that soils, the chief source of man's wealth, are the repositories of plant-foods which unwise use may exhaust all too soon; that cyclones possess decided economic value since to them we are chiefly indebted for our copious rains; that the "magician chlorophyll, conjuring with sunbeams" breathes life into dead matter and makes an animal kingdom possible; that birds and bees labor incessantly in making man's harvest abundant; that the chief use of the earth-worm is not to veneer a fish-hook, but to enhance the resources of the soil by keeping it rich and porous; that even invisible organisms render the highest service to man, as when bacteria accomplish the fixation of nitrogen in leguminous plants; and finally, that the forest, the nature-given heritage which man has so wantonly devastated, serves man directly in a score of ways, and indirectly it enriches and protects the soils, prevents disastrous floods, secures constant heads to our streams, breaks the biting blasts of winter, and makes beautiful landscapes that otherwise would be barren and monotonous.

Even above the value of practical knowledge, the student of nature may discover the steadfastness and immutability of God's law. He may be convinced that retribution follows its transgression, in the physical as in the spiritual world, with unfailing certainty; and finally, that to him who is in harmony with nature, and therefore most likely to be "in tune with the Infinite," shall come "length of days, riches and honor."

There are still people who believe the earth to be top shaped or pear shaped. This should warn us to use a globe freely in our class rooms; to illustrate the globular form of the earth, not merely to talk about it.

EDITORIAL

THE TRAINING FOR TEACHERS OF GEOGRAPHY IN ELEMENTARY SCHOOLS

THE teacher of geography in elementary schools has the most difficult task of any geography teacher, for she is called upon to teach the elements of a subject so vast and involved as to tax the powers of the most eminent investigators and students. A teacher in the elementary grades is expected to analyze the whole subject and to present to children in the third or fourth grades geographical relations which no one can adequately study without a preparation in many sciences other than geography. The controls that determine the geographical relations of men to one another and to their environment are the most subtle and difficult phases of geographical study. These relations, illustrated in a greater or less degree in every locality, are the best phases of the subject to receive attention in the earlier grades, and as a rule are taught by teachers who cannot be expected to have any expert knowledge of the subject. The subject matter of the upper grades is not so difficult of study or appreciation and teachers of regional or continental geography can get along without expert training in geography better than can teachers in the earlier grades.

The work of elementary teachers of geography may be divided into two parts—the teaching of the principles of geography and of regional geography. These are the two phases of the subject that, from one standpoint or another, make up the work of an elementary course of study. Those charged with the responsibility of arranging courses in geography in normal and training schools need to recognize what the future teachers are expected to know and to plan their courses accordingly.

Yet a study of the usual courses in training and normal schools would seem to indicate that these facts are not kept in mind. Training in understanding the fundamental controls of life distribution and life relations over the world can not be given through courses in physical geography alone. Important as an understanding of physical geography is in all geography teaching, no teacher is prepared to teach geography well who has not studied also the elements of plant and animal geography as related to climate, surface, drainage and soil, and of political and commercial geography as related to all the controls. Following such a study of the principles as outlined in the introduction to the usual grammar school geography, should be some training in the application of these principles to the study of some

one continent or country, to show how regional geography should be studied and approached.

These two phases of the subject would seem to be the minimum preparation in subject matter which would adequately prepare teachers to use understandingly any one of the elementary text-books.

Students who have had such training in personal study will be prepared not only to lead their future pupils to proper methods of studying geography, but will be able to appreciate and make good uses of the principles and details of a course in geography teaching. It goes without saying that no teacher can receive value from studying the methods of teaching a subject she is not familiar with. The knowledge of subject is therefore a necessary basis for the study of methods of teaching.

Common sense and the general content of school geography, as determined by courses of study and text-books, certainly dictate that we should prepare teachers in those phases of the subject which they must teach; and second that we must give them as much as we can in reference to teaching different phases of the subject in the different grades.

A rational course of study for pupil teachers would seem to include three parts:

1. The principles of geography in which physical geography should receive strong emphasis, but which cannot be confined to physical geography alone, as is so often the case.

2. Regional geography of at least one country, in which the principles of geography are applied and from the study of which power will be gained to study and teach other countries adequately.

3. The teaching of geography, which should include (a) a study of the underlying principles of good geography teaching, (b) the application of the principles of teaching, and (c) the study of the course of study and the special problems of the different grades.

Training school courses in geography need to be as closely planned for practical usage, as school courses of study do. We are constantly emphasizing the necessity of teaching geography so that school pupils will receive the best training for the comprehension and study of geography in after life. For the same reason should not the geography in normal and training schools be arranged so that the pupil teachers will be best prepared for their tasks in geography teaching in after life? Does not this mean that our courses shall be broader, deeper and less one-sided than they now are?

REVIEWS

THE ELEMENTS OF GEOLOGY.—William Harmon Norton, 461 pp., 374 Illustrations. New York, Ginn & Co., 1905.

ONE of the much-discussed problems of the present day in High School teaching is concerned with the selection of geologic and physiographic material for a course in Earth Science, the time given to the subject being from one-half year to a year. A not unreasonable solution of this problem has recently been suggested by offering a course in geology and expanding the physiographic chapter of the subject to something like the proportions, even if not the dignity, of a separate course. Besides this, the historical chapter is shortened very considerably usually on account of a lack of laboratory material, and because the interpretations, involving as they do, a combination of more or less difficult stratigraphic and palaeontologic principles, with extensive field work, are out of reach of both teacher and class. In physiography, on the other hand, distant processes and forms may be illustrated in miniature in the local field under conditions not usually prohibitive.

The above teaching conditions seem to be fairly met in Norton's Elements of Geology, an elementary text-book for the High School and College. The first half of the book deals with external geological agencies and their resulting forms, the quality of the treatment being suggested by the fact that this section was arranged to meet the approval of Professor Davis.

If to this chapter is added the following one on internal geological agencies and the physiographic chapter still further enlarged with the help of a good text-book in Physical Geography, a good course could be arranged.

The wisdom of the plan of giving equal treatment to all phases of the subject in an elementary course is to be doubted. In *The Elements of Geology,* minerals and rocks are treated in a very simple manner and in immediate connection with the processes and conditions which determine them. This is reasonable from a pedagogic point of view and is not inconsistent with the arrangement of College and University courses in continuation of the subject. The chapter on Historical Geology is brief, clearly written, and treats chiefly of the development of North America, and is therefore a good basis for an elementary college course, but we question whether Historical Geology should be included in a High School course at all, any more than that Conic Sections should be taught in every course in Solid Geometry. It is important to recognize that we are discussing the use and not the construction of a book, as no single book can possibly meet the complex

conditions of our school system. The diagrams in this book are very clear, and with the cuts, excellently illustrate the text, the maps representing the geography of the continent of North America in each geological period being more nearly correct than any published heretofore. This is not a matter of the technology of illustration. Compare Fig. 264, for example, with any other map representing the Physical Geography of North America at the beginning of the Cambrian. They are fundamentally different. Our present better knowledge of the distribution of these rocks and their relation to the previous terrane is here cartographically expressed for the first time. The questions at the end of each chapter are unusually suggestive and effective, and should form an important part of the instruction.

The frequent errors of terminology and composition illustrated on pages 87, 89, 93, 96, 98, and 101 are regrettable, but, except in a few cases, do not lead to confused ideas on the subjects treated and therefore should not be taken too seriously. I. B.

ECONOMIC GEOLOGY OF THE UNITED STATES.—Heinrich Ries, 8vo. New York, The Macmillan Co., 1906.

In the teaching of geography much emphasis is of necessity placed upon the economic resources of the various countries. The agricultural products are naturally those given especial prominence but as time has gone on the mineral wealth has come more and more into the foreground. This is particularly true of the United States whose output of coal, oil, iron, copper and lead is in each case foremost in the columns of the statisticians and whose gold and silver are but slightly inferior.

In order that a teacher may clearly and correctly place before a class the mineral products of each country it is necessary for him or her to have some knowledge of geology and to view these matters from a geological standpoint. The book before us does this, and gives a brief but succinct description of the modes of occurrence and distribution of practically all forms of mineral resources in the United States. The subject matter is well illustrated by maps, and the reader will readily gain good ideas of distribution and occurrence. The United States are alone treated but the occurrence of the metals and non-metallic minerals within their borders is typical of the rest of the world as well.

Starting with a basis such as the work before us affords, and year by year amplifying it with the statistical reports like the Mineral Resources of the United States Geological Survey, and the Mineral Industry of the Engineering and Mining Journal, the teachers of older classes will be able to present this side of geography with all the necessary fulness, interest and accuracy. J. F. K.

RECENT PUBLICATIONS

THE WORLD ALMANAC AND ENCYCLOPEDIA FOR 1906. The Press Publishing Co., New York, 1905.

The recent annual World's Almanac, like its predecessors, is an indispensable reference volume for the thousand and one items of geographic information which are rarely needed but which are needed badly at times.

BIBLIOTHECA GEOGRAPHICA, Vol. X, 1901. W. H. Kühl, Berlin, 1904.

The latest annual Bibliotheca Geographica, like its predecessors is a full bibliography of geographic literature for the year reviewed. Includes all phases of geography and is a necessary reference volume for specialists in geography.

EUROPE AND THE MEDITERRANEAN REGION. J. B. Reynolds, pp. 128. London, A. & C. Black, 1905.

A brief digest of the geography of Europe in general and the Mediterranean countries in particular, excellently illustrated by cuts and maps. Written by an expert teacher with a strong emphasis of causal relations. Valuable for reference in the upper grades in American schools.

ARTICLES IN THE CURRENT GEOGRAPHICAL MAGAZINES

THE DELTA OF THE RIO COLORADO, by D. T. Macdougall, *Bulletin, American Geographical Society,* January, 1906.

An interesting illustrated account of the little known delta of the Colorado river, including the plant life and Indian inhabitants.

THE FLORIDA KEYS, by John Gifford. *National Geographic Magazine,* January, 1906.

An illustrated account of the Florida Keys, describing the route of the railroad now under construction to connect Key West with the main land. Describes the products and agricultural conditions of the Keys and includes excellent pictures of sponges, green turtles and alligator eggs.

THE SPHERE AND USES OF GEOGRAPHY, by Sir C. R. Markham, *Geographical Journal,* December, 1905.

A summary of the value of geographic training in the education of all.

NOTES ON THE HISTORY OF THE NILE AND ITS VALLEY, by W. F. Hume, *Geographical Journal,* January, 1906.

A description of the Great Plains of the Sudan and of the Cataracts.

THE GEOGRAPHICAL CYCLE IN AN ARID CLIMATE, by W. M. Davis, *Geographical Journal,* January, 1906.

An analysis of the development of land forms in an arid region, contrasted with the cycle in humid regions.

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NOTES

RECENT DECISIONS OF U. S. BOARD ON GEOGRAPHIC NAMES.

Big Flats: Town, Chemung county, New York. (Not Bigflats.)

Blocton: Town, Sibb county, Alabama. (Not Blockton.)

Gorham: Mountain, Mt. Desert Island, Hancock county, Maine.

Icicle: Stream emptying into Wenatchoe river, near Leavenworth, Chelan county, Washington. (Not Nacicle.)

Ignacio: Lakes west of Animas canyon, La Plata county, Colo. (Not Bishop, Columbine, Hamor, Molar, Pierce, nor Rockwood lakes, nor Cascade reservoir.)

Katalla: Bay, river, slough, and town, Alaska, near Controller bay, Gulf of Alaska. (Not Catalla nor Catella.)

Navajo: County, creek, reservation, spring, town, and valley, Navajo county, Arizona. (Not Navaho nor Navajoe.)

Uinta: County, mountains, reservation, river, town, and valley, Uinta county, Utah. (Not Uintah.)

*Wetumpka: City and precinct, Elmore county, Alabama. (Not Wetumka.)

CURRENT ARTICLES ON COMMERCE AND INDUSTRY.—

January:

Adulteration: How Housewives Can Tell Adulterated Foods, *Ladies' Home Journal.*

Austrian Textile Industries, *Consular Rep.,* Dec.

Camphor Monopoly by Japan, *Consular Rep.,* Dec.

Cattle Statistics of the World, *Hide and Leather,* Jan. 27.

Chinese Empire (styles, copper coins, mints, salt, tea) *Consular Rep.,* Dec.

China, The Awakening of, (Ill.) *World's Work.*

Cotton-growing: Report of Brit. Cotton-Growing Ass., *Consular Rep.,* Dec.

Electro-Technical Industries, *Sci. Am.,* Jan. 20.

Farming as a Business Enterprise, *Rev. of Revs.*

Fruit Growing, Tropical, in Florida, (Ill.) *Country Life in Am.*

Gold, The Increasing Supply of, *Moody's Mag.,* Dec.

Investors, Small, Guiding Principles for, *World's Work.*

Korea, Japanese Seizure of, *World To-Day.*

Linseed Oil, *Paint Oil and Drug Rev.,* Jan. 3.

*Reversal of former decision.

Lumbering: White Cedar and Hemlock, *Miss. Valley Lumberman,* Jan. 12.

Lumbering: The Advent of Yellow Pine, *Miss. Valley Lumberman,* Jan. 26.

Porto Rico, Labor Conditions in, *Bull. of Bureau of Labor,* Nov.

Porto Rico, Our Experience in, (Ill.), *World's Work.*

Railway: The Private Freight Car System, *Sat. Evening Post,* Jan. 6 and 20.

Railway: The Private Car and the Beef Trust, (Ill.), *McClure's Mag.*

Rice Production in the U. S., *Crop Reporter.*

Switzerland: Unsurpassed Material Prosperity, *Consular Rep.,* Dec.

Telephone, The Far-Flung, (Ill.),*World To-Day.*

Water-Power at High Pressure, *Sci. Am.,* Jan. 6.

HYGIENE IN THE TROPICS.—Under the special conditions of tropical climates, the resident who comes from a cooler latitude needs to take special precautions regarding his mode of life and personal hygiene. A rational temperate mode of life, especially the avoidance of alcoholic excess; regular exercise; non-fat-producing food; clothing suited to the climate, such as duck or linen for outside garments during the day and light woolen for the cool of the evening and night; careful attention to the site and construction of dwellings; all possible sanitary precautions; keeping cool during the warmest hours and season by the use of fans or punkahs, by frequent baths and by abstaining from hard work; protection against mosquitoes by means of screens; frequent change of climate by returning to cooler latitudes,—all these are important. It seems like a contradiction, but it is a fact, that the danger of taking cold in the tropics is very great, and must be carefully guarded against. General Wolseley is reported to have said of the tropics, "not to get cold is to avoid almost certainly all the causes of disease," and a recent writer has well said that these words should be inscribed on the walls of all barracks in the tropics. The situation may be summed up in the rule: "Respect the sun, and rain and wind; clothe with a view to avoiding chill, and live temperately." The danger of becoming chilled is greatest during the cooler hours of evening and night; during rains, or when cool winds blow. The skin does not react well in the tropics, hence chills are frequent with even slight temperature changes, especially when there is wind. As to the best style of dwelling for the tropics, there is no absolute agreement. The material can best be determined by the local conditions in each case: wood, stone and thatch are employed successfully.—*From the Hygiene of the Zones, Bulletin Geographical Society of Philadelphia, January,* 1906.

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SOME GENERAL RELATIONS OF CLIMATE AND HEALTH.—From earliest times people have sought in atmospheric conditions an explanation of the occurrence of disease, and have often found in statistics of mortality and of weather a more or less striking parallelism. Many fairly obvious large facts naturally point to some relation of cause and effect in this matter. Some diseases are found principally in the warmer climates; others seem to prefer the colder. Some are usually more active in the warmer, or the dryer, months; others have shown the contrary relation. Higher altitudes are free from some diseases which prevail near sea level and have certain favorable climatic characteristics long recognized in the treatment of disease. The pure air, increased respiration and deeper breathing are stimulating and health-giving; beneficial in many affections of the lungs, although occassionally over-stimulating in nervous and cardiac troubles. In the case of other diseases, again, altitude has no effect. Dry climates, especially deserts, whose air is usually exceptionally pure and aseptic, are generally healthful, and are beneficial in many cases where mountain climates are too stimulating. The climates within forested areas have proved especially favorable in cases of phthisis. Ocean air, pure and dust-free, with its saline constituents and equability of temperature, is beneficial to most persons as a moderate tonic and as a restorative in many illnesses. Winds are important agents in promoting health. The cool, refreshing sea-breeze of the tropics brings in pure air from the sea and is one of the most important desiderata in hot climates. Winds are active ventilating and purifying agents where population is congested. Fogs and clouds, by cutting off sunlight, weaken one of the best agents in promoting health, for the germicidal action of sunlight has been proved by many investigators. Sternberg has called it "one of the most potent and one of the cheapest agents for the destruction of pathogenic bacteria," and says "its use for this purpose is to be recommended in making practical hygienic recommendations." In London, a higher death-rate after a long fog may, however, result from the lower temperature during the fog, and not from any direct effect of the fog itself.—*From the Hygiene of the Zones, Bulletin of the Geographical Society of Philadelphia, January,* 1906.

THE HUMAN ELEMENT IN GEOGRAPHY.—The studies of the Educational Research Club of Hartford county, Conn., show that boys and girls, particularly the latter, dislike geography. Schoolroom experience teaches about the same thing, or, to be more exact, it teaches that a very few like the subject, that a good many dislike it, and that a great many regard it with indifference. The subject is not difficult enough to be cordially hated, and is not interesting enough to be generally liked.

But geography is not inherently uninteresting. It is only the victim of shabby treatment. The child revels in particulars, and fights clear of condensed statements of fact. Many books prepared for his use, however, are mere summaries of what it would take a small library to contain in readable form. There is much more wisdom in such books than in the writing of them. They would take the child by flying leaps from peak to peak of towering knowledge, without permitting him to tread the intervening path with his own feet. And what of it? Well, he doesn't leap, that is all. He likes the touch-and-go movement, but cannot be expected to vault six-foot fences or clear twelve-foot ditches. Besides, great geographical facts follow each other in such rapid succession that the mind is not applied to any one long enough to overcome the inertia of interest.

The child wants to know what people are doing and how they do it. To tell Southern boys and girls that the winters of Iowa are cold is only a cold statement of a cold fact, and it is coldly received. But tell them how the snows of winter affect the life of the people—how they dress and build to keep warm, how they travel over the snow, what sports the children have—tell them about people, large and small, and the feeling of kinship will spring up and do the rest.

Yes, it would take a dozen large volumes to hold all the geographical knowledge, thus elaborated, that is now crowded into our courses of study. But it would require only one small volume, even when written in a diffuse style, to contain as much as the average child gets out of our multum-in-parvo courses. What the child can learn is not to be measured in typographical ems. Nor is it to be inferred, because he cannot digest a pound of dry bone in nine months, that he cannot digest twelve pounds of meat in less time. If geography were written in an attractive way, the child would read many times the number of pages he now reads, and understand the subject better without the teacher's assistance than he now does with it.

Let us have a little more human life in our geographies, even if they do cost more. The book that awakens interest is cheaper at any price than the one that does not.—*Journal of Education.*

A Vocabulary of Japanese Words Occurring in Geographic Names

A. Adjectives.

shiro (shira)	= white
kuro	= black
aka	= red
a'o (awo)	= blue
ki	= yellow
midori	= green
ô (ôki), tai (dai)	= great, big
ko, shô	= small, little
takai, taka	= high
hikui	= low
yoko	= transverse

B. Words denoting location.

higashi, tô	= east
nishi, sâi, (se'i)	= west
minami, nan	= south

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kita, hoku = north
kami, jo = upper
shimo, ge = under, lower
naka, chû = between, middle
ma'e, zen = before
ushiro, go = after, behind

C. The land.

kuni, koku (goku) or shû = country, province
tai-riku = continent
ken = department, district
kori (gori) = county
shima (jima), tô = island
han-tô = peninsula
yama, san (zan) = mountain
nobori = same, in Aino language
san-miya'ku = chain of mountains (literally: pulse of mountain)
yama = wild, (literally mountain-grown) in names of wild flowers, animals etc.
mine = summit, crest
take (dake) = high peak
tôge = mountain pass
saki (misaki) = point, promontory
sakai = boundary
tani (dani) = valley
hira (hirachi) hêgen = plain, lowland
taira (daira) = same, in a few special names
hayashi = forest
mori = grove
hara, no (nohara) = an opening in the forest
numachi = bog
ta = rice-field
inaka = country (contr. to city)
jôka = residential city (of a daimio)
miyako, fû = capital
machi = street, town
mura = village
shiro = castle
goten = palace
tera (dera) = temple of Buddha
miya = shinto temple

D. Fresh water.

minamoto, suigen = river
kawa (gawa), ka = spring, source
kuchi (guchi), kako = mouth
taki (daki), bakufu = waterfall
yama-midzu = mountain stream
tani-gawa = same
taika (taigo) = large river; more frequently the prefixes ô and ko denote the size, as ô-kawa or ko-gawa
hori = canal
midzu-umi, kosui (ko) = freshwater lake
kata (gata) = lagoon pond
ura = bay
ike = pond
numa = swamp
ide-yu (onsen) = hot spring
yu = hot water
midzu = cold water
jigoku = hell, solfatara

E. The ocean.

O-nada, tai-yo (tai-kai) = ocean
umi, kai = sea
uchu-umi (naka-umi) = inland sea
iru-umi, ura (wan) = bight
nada = part of the ocean, bight
seto, kai-kiô = straits
minato (tsu), kô = harbor
hama = flat, sandy shore
shio = ocean current, tide
kuro-shio = Jap. Gulf stream
oya-shio = cold Kurile current
hiki-shio = flood tide
michi-shio = ebb tide

REMARKS

1. *a, e, i, o, u,* are sounded as in Latin.
2. Two vowels are always sounded separately: *tai=ta-i, se'i=se'—i.*
3. No vowels are mute: *ike* is two-syllabic.
4. A circumflex over a vowel: *â, ê, î, ô, û,* means a long sound.
5. *taki* (*daki*), *kuchi* (*guchi*): when words beginning with *t, k, s,* or *h,* follow a vowel in a compound name, *t* changes into *d, k* into *g, s* and *sh* into *z, ts* into *ds, ch* into *j, h* (*f*) into *b.*
6. *Miyako, fû*: With the introduction of Buddhism and Chinese civilization, a great many words of Chinese origin were naturally introduced into the Japanese vernacular (*Yamato-kotoba*). These words, which have preserved the Chinese spelling but whose pronunciation is entirely different from the Chinese, form the *Sinico-Japanese* constituent of the language. Many objects have both a Yamato-kotoba and a Chinese name. In all cases occurring above, where two names are separated by a comma, the word *before* the comma is the *Yamato,* the word *after* it is the *Sinico-Japanese* name.

Adapted from Rein's "Japan," 2nd edition, 1905.—*M. K. G.*

SOURCES OF THE COFFEE SUPPLY.—The origin of coffee is lost in the mists of antiquity, but the plant is believed to be a native of Abyssinia, and to have been carried thence into Arabia early in the 15th century. From Arabia the Meccan pilgrims carried it to all parts of the Mohammedan world. Americans are by far its largest consumers to-day, absorbing about half of the world's product.

Coffee is essentially a tropical plant and is limited to parallels of twenty-five degrees north and south latitude. The best is grown in Arabia, but not one pound of the Mocha coffee, so called because it is exported from that place, reaches the United States. The Mocha with which Americans are familiar is grown in the Western hemisphere, and does not resemble the Arabian bean.

The other coffees familiar in this country are the Java, from the East Indies; Maracaibo, from South America; Mexican, Central American, and Santos, from Brazil. The country last named furnishes two-thirds of the world's supply.—*The Search Light.*

WORLD'S LONGEST TUNNEL.—The Simplon is the longest tunnel in the world, and has been finished in the face of tremendous difficulties, most of which were entirely unexpected, and many of which presented new problems for engineers. It extends from Brieg in Switzerland to Iselle in Italy, the total length being a little over twelve and one-fourth miles—21,576 yards in fact. In comparison with other great tunnels, the following table will be interesting:—

The Simplon	12¼ miles
St. Gotthard	9¾ "

Mont Cenis	7½ miles
Arlberg	6¾ "
Hoosac (U. S.)	4¾ "
Severn	4 1-3 "

THE PORT OF MANAOS—The port of Manaos presents to the observer two entirely different aspects according to the time of the year in which it is visited. Either the waters of the Rio Negro are seen pressing the rough wall along the river's side, as though it were endeavoring to reach the same level as the streets, thus giving the false impression of an exceptionally easy and cheap service of loading and unloading, for vessels may come directly up to the small warehouses along the shore, and the anchorage may be said to be within the city—and this is the rainy season, December to May—or, if visited during the dry season, there will be seen a space from 100 to 130 meters in width between the level of the river and the base of the wall which runs along the river front, the difference in level between these two points being 15 meters.

This phenomenon which occurs in the Amazon River and is reflected in its principal affluents, causing ordinarily six months of high water and six months of low water, is not common, and is almost unknown except in Brazil.

Such an anomaly made impossible the installation of works ordinarily erected for the mooring, loading, and unloading of vessels directly at the wharf, and it therefore became necessary to study a system which would be feasible and at the same time economical. The only solution presented was the construction of anchored pontoons forming perfect floating docks, and placed as near as possible to the shore, but at a point where there should always be plenty of water, even in the season of low water, for the mooring of vessels of the largest draft. The first pontoon having a length of 200 meters and a width of 20 meters has already been built on water-tight cylinders, having a diameter of 2 meters and a length of 5 meters. Four of these cylinders placed side by side form the width of the dock, and 30 of these cylinders, placed at intervals of 30 centimeters, form the length of the dock. On these cylinders are placed, running lengthwise, five rows of iron beams in rectangular-section, and on these are seated, transversely, double T-shaped beams which receive the floor of the dock. A system of aerial wires is used for the transportation of merchandise from the dock to the warehouses.

The wires or cables are suspended from three steel towers located on the pontoon and three others also of steel on large pillars of masonry on the land slide, in the center of the wood platform. The cables are firmly

fastened to the pontoon towers, and on the land side to the large counter weights which move in grooves placed in the rear part of the platform towers. In this way the cables, whether empty or carrying freight, sustain the same strain. Directly under the pontoon towers, and below the cylinders forming the structure of the pontoon, are sunk six cylinders. The regulating levers and commutator are installed in a small cabin halfway up the side of each of the pontoon towers. The towers on the land side are 15 meters high and those on the pontoon 21 meters, and the span between these is 153 meters. This pontoon is fastened in front to the platform and is also secured by ten anchors placed parallel to the platform, which prevent any movement. The chains of the anchors are tightened or loosened, according as the waters rise or fall.—*Monthly Bulletin Bureau of American Republics.*

VANILLA.—The vanilla seen in the beautiful forests of San Salvador, Costa Rica and Nicaraugua belongs to the species known in commerce as "vainillón"—that is to say, the ordinary vanilla. Its pods, which measure from 14 to 19 centimeters in length by 14 to 20 millimeters in width, are almost black, soft, viscous, have a strong odor, but not as pleasant as that of the other species, and consequently are in less demand.

In commerce the genuine vanilla bean is usually sold, this being the the only kind employed in the manufacture of perfumes and other industries; it being known by its length, which varies from 16 to 20 centimeters, its width being from 7 to 9 millimeters, wrinkled up lengthwise, bent at the base, of a dark-brown color, soft, viscous, strong odor, and quite aromatic, covered at times with crystals of benzoic acid. A thinner vanilla bean is also sold, drier and of a lighter color, though less aromatic than the former; finally, the third class is our vanilla—that is to say, the "vainillón," or ordinary vanilla, which is the kind commonly found here and for which there is not so much demand on account of its being less aromatic.

The first of this kind also is found here, although it is not so abundant, and even the wild vanilla is not properly prepared here for export. The plant is a climbing orchid, sarmentose, which fastens itself by means of special roots, called "claws," to the trunks of the trees in the shady forests so abundant in several regions of Nicaraugua. It is frequently found in the Province of Matagalpa, in the forests adjacent to rivers and streams.

The stems of the vanilla plant are of a cylindrical shape, green, knotty, of the thickness of a finger, and from every knot there branch off roots or claws which are firmly implanted in the bark of live and generally very high trees. These roots serve to support the vine, which sometimes extends along the ground to a distance equal to the height of the tree which it en-

circles, and also serve to nourish the vine by absorbing the humidity of the bark. The leaves have no peduncle, but shoot from the stem, alternate, far apart, elongated, shaped like a wide lance, thick, lustrous, provided with longitudinal grooves. The flowers are on the top of the stems in axial bunches, of a light yellow and are aromatic. The fruit is a fleshy capsule, green when young, and of a dark brown when mature; it is long, cylindrical, very aromatic, and therefore much sought after by birds; it contains a great number of small, black, oval, lustrous seeds, covered by a black, thick and balsamic pulp.

Heretofore Mexico has been the only country that has exploited on a large scale this precious product, supplying the European markets, where vanilla is sold at a high price. Should the Salvador species be cultivated, as is done at Papantla and Misantla, Mexico, the plant would develop to better advantage and produce a fruit more valuable than that which is at present obtained from the chance harvest secured in the forest before the fruit is matured, the fruit being poorly prepared, and almost without aroma.

The planting of this vine is very simple. Plots of black, smoky, loose, and damp soil are selected, where there are trees having few branches and at some distance from each other. The ground should be cleared, leaving only trees, at the base of which the vines should be planted and fastened to the trunks until the roots adhere to the bark, this being obtained by means of the humidity produced by the rains, the rainy season being the time for planting the vines.

Vanilla can be cultivated together with other crops. Vines prosper and yield abundant fruits when planted at the foot of cocoanut and other fruit trees. All that is needed is sufficient light, air, humidity, and that the sun penetrate through the branches down to the plants, and for this reason it is advisable to select trees which have fine leaves.

It is almost impossible to produce the vanilla plant from the seed. Generally, for planting, pieces of the vine from sixty to eighty centimeters in length are cut, and these pieces are planted in holes of from eight to ten centimeters deep, then the hollows are covered with earth and are lightly fastened with banana filaments or tree moss to the trunk until the stems develop roots in the knots, which are the claws by which the vine is kept attached to the trunk.

In order that the vines may obtain a firm hold, the planting is done in May or June, after the rainy season has set in. Four to six months thereafter the soil is freed from weeds, the vines that have not been properly entwined are straightened, and the rotten or dry ones are replaced.

At the end of three years the vine is greatly developed and creeps up

through the branches until covering the same, and then it commences to bear fruit. The crops are good until the ninth year, when the plant begins to degenerate, and the yield is scant, and then it should be replaced by new vines planted on the opposite side of the old ones, or the latter might be torn out by the roots if there are not sufficient trees to plant in some other place. As a general rule, it is in the dry season, near the months of December and January, when the crop is ready for harvest. By that time the pods are entirely ripe and of a smoky yellow color, emitting a pleasant aroma, which attracts many birds, for which reason many planters cut it while green, which injures the aroma of the fruit.

The male and female flowers being in separate bunches, it becomes necessary to fertilize them artificially by shaking the pollen of the male flowers over the female flowers. Without this precaution the plant yields not more than thirty to fifty pods, whereas by the artificial method each vine produces from 250 to 300 pods.

As the vanilla vine often grows along the higher branches of the trees to which it adheres, it is necessary that the pod gatherers use wire ladders with iron hooks, which they fasten to the branches or trunks. To transfer the pollen a stick with a ball of cotton at one end is sufficient, it being used to touch the female organs of the flowers, an operation which should be done each morning, inasmuch as the flowers are closed by the sun about nightfall. Children and women may be employed in this operation to gather the barren flowers that generally fall from the plants two days after coming into bloom.

The capsules should be gathered as soon as they commence to become yellow, and before they are in full bloom, for besides being eagerly sought by birds when they are in such condition, they lose almost all their aroma. In cutting the fruit the necessary care should be taken not to injure the stem from which the bunch hangs, because it becomes rotten easily at the time of preparing it.—*Monthly Bulletin Bureau of American Republics.*

THE WORLD'S PETROLEUM SUPPLY.—The United States supplied more than one-half of the petroleum produced in the world in 1904. A statement of the world's production of petroleum, prepared by the British Board of Trade, which has just reached the Bureau of Statistics of the Department of Commerce and Labor of the United States, puts the petroleum production of the world in 1904 at 9,303,000,000 gallons, of which 4,916,000,000 gallons were produced in the United States, 3,650,000,000 gallons in Russia, 202,500,000 gallons in Austria, 206,500,000 gallons in Java and Sumatra, 135,000,000 gallons in Roumania, 105,500,000 in British In-

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dia (principally Burma) 49,000,000 gallons in Japan, 20,000,000 gallons in Canada, and 18,500,000 in Germany.

These figures give the grand total of 9,303,000,000 gallons of petroleum production in 1904, a total which far exceeds that of any earlier year. In 1903, which made the highest record of any year prior to 1904, the total was but 8,504,000,000; in 1902 it was 7,588,000,000. This increase in 1903 and 1904 occurs chiefly in the United States. The figures of production in the United States show an increase of about 697,000,000 gallons in 1904 over the figures of 1903, while those of Russia, our chief competitor in oil production, show an increase of but 103,000,000 gallons over 1903, and the increase in the United States in 1903 is also much larger than that of Russia. In the four years, 1898, 1899, 1900, and 1901, Russian production of crude petroleum exceeded that of the United States, but in all other years for which the record is shown by the publication in question, extending from 1883 to 1904, the production of the United States exceeds that of Russia, and by far exceeds that of any other country. Indeed, it may be said that the United States and Russia produce practically nine-tenths of the petroleum of the world, the total production in 1904, as above shown, being 9,303,000,000 gallons of which 8,556,000,000 were produced in the United States and Russia combined.

Exportation of illuminating oil, or kerosene as it is familiarly called, is also much greater from the United States than from Russia, especially as American crude oil gives a much larger per cent. of illuminating oil than does that of Russia. The total quantity of refined illuminating oil exported from Russia in 1904 was 455,000,000 gallons, and from the United States 761,000,000 gallons. Russian exports go largely to southwestern Europe, northern Africa, and southern and eastern Asia, while western Europe, eastern Asia, Oceanica and North and South America are the most important markets of the United States. Of the 876,000,000 gallons of refined oil for all classes (including napthas and lubricating oil) exported from the United States in the calendar year 1904, 201,000,000 gallons went to the United Kingdom, 117,000,000 to Germany, 112,000,000 to Netherlands, 41,000,000 to Belgium, 24,000,000 to France, 74,000,000 to other countries of Europe. In eastern Asia 70,000,000 gallons went to China, 39,000,000 to Japan, and 24,000,000 to Hong Kong, while 25,000,000 gallons went also to southern Asia under the general title of British East Indies, and 26,000,000 gallons to British Australasia. In America the distribution was to Brazil 20,000,000 gallons, Argentine Republic 16,000,000, British North America 19,000,000, Chile 6,000,000, Central America 2,000,000, Cuba 2,000,000, and Mexico 1,000,000.

Petroleum has formed of late years an important factor in the exportation of the United States. Prior to 1905 it was the largest single item in the statement of exports of manufactures, but in that year copper for the first time exceeded petroleum in the value of exports. The total value of all classes of iron and steel manufactures exported, of course, exceeds by far the total of petroleum, but no single item in the group entitled iron and steel manufactures is as large as the item of illuminating oil under the general head of refined mineral oil exported. The total value of iron and steel manufactures of all classes exported in the decade ending with 1905 was $943,886,511, of refined mineral oil $622,313,762, and copper and manufactures thereof $444,878,552, while the next largest item is leather, $272,534,562, and cotton manufactures $259,136,044.—*Monthly Bulletin Bureau of American Republics.*

THE NEBULAR AND PLANETESIMAL HYPOTHESIS[1].—The planetesimal hypothesis of Professor T. C. Chamberlin and others assumes an origin of the earth directly opposite to that according to the nebular hypothesis propounded by Kant and Laplace. The latter hypothesis holds the existence of a mass of incandescent vapor which by condensation and rotation was differentiated into successive rings; the latter being gathered up into planets *while still retaining intense heat.* The new hypothesis assumes that the disseminated planet-forming matter had *lost its heat* while yet existing in the loose form, as rings or zones of the parent nebula, and that the globular planets were *formed by the slow accretion or infalling of cold, discrete bodies or particles* (planetesimals). The old hypothesis assumes an original hot globe, with shrinking on account of cooling; the new regards the globe as originally and always cold at the surface, and the interior heat as the product of condensation through gravity. While the old hypothesis involves the existence of a primal heated atmosphere and ocean consisting of the more volatile substances of the earth's mass, the new derives the atmosphere and ocean from the earth's interior by a slow process of expulsion due to pressure and heat. A complete outline of the Planetesimal hypothesis may be found in the Chamberlin and Salisbury's Geology just published.

[1]Prepared by Department of Education, Albany, N. Y., and published at the request of teachers using the 1905 Syllabus in Physical Geography and Agriculture.

THE KNOWLEDGE OF GEOGRAPHY

"A man may know a million facts but unless they are built into a definite system they do not constitute science." Information about the ways of people in different parts of the world only becomes geographic knowledge when those facts are organized causally.

NEWS ITEMS

The Geographical Association of Britain, formed a number of years ago to promote geographical education in the United Kingdom, reports greatly increased interest in its work during 1905. The total membership is now 503, ninety-eight new members having been added during the year. Branches have been established in Bedfordshire, Bournemouth and South Africa. Exhibits have been held in various places, and the *Geographical Teacher,* the official publication, has been regularly published under the effective editorship of Dr. Herbertson.

Professor Albrecht Penck, of Vienna, has accepted the professorship of geography in the University of Berlin, made vacant by the recent death of Professor von Richthofen.

An exhibit of geographical equipment available in teaching will be held in the Educational Museum of Teachers College, New York City, for three weeks beginning March 26. A cordial invitation to attend is given to all interested.

Professor Albert P. Brigham, of Colgate University, will lecture at the University of Wisconsin, Madison, Wisconsin, during the summer session of 1906, and Miss Ellen C. Semple, of Louisville, Ky., will lecture on Anthropogeography at the University of Chicago during the summer term.

The Bulletin of the Geographical Society of Philadelphia will hereafter appear at quarterly intervals, instead of irregularly as heretofore. The first number for January 1906 is at hand and is attractive in makeup and strong in its contents.

A course of lectures and practical work in geography will be given at the School of Geography of the University of Oxford from August 7 to 25, 1906. Excursions will be a strong feature of the work and some attention will be given to field demonstration of map drawing and surveying.

The School of Geography at the University of Oxford, established in 1899, has conferred nine diplomas upon candidates who have completed (three with distinction) the required course. The diploma is awarded after one full year's work to students who pass satisfactorily a theoretical and practical examination in Regional Geography and two of the following subjects: Climatology and Oceanography, Geomorphology, Ancient Historical Geography, Modern Historical Geography, the History of Geography, Surveying.